

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appellant(s) : Toshiharu FURUKAWA et al. Group Art Unit: 1792
Appln. No. : 10/711,758 Examiner: DAHIMENE, Mahmoud
Filed : October 4, 2004 Confirmation No.: 5757
For : REDUCED MASK COUNT GATE CONDUCTOR DEFINITION

APPEAL BRIEF UNDER 37 C.F.R. §41.37

Commissioner for Patents
United States Patent and Trademark Office
Customer Service Window, Mail Stop Appeal Brief-Patents
Randolph Building
401 Dulany Street
Alexandria, VA 22314

Sir:

This appeal is from the Examiner's rejection of claims 1, 4-10, 12-14, and 21-28 as set forth in the Final Office Action dated August 18, 2009. A Notice of Appeal was timely submitted on October 15, 2009. This Appeal Brief is being filed by the initial two-month due date from the filing of Notice of Appeal, i.e., December 15, 2009. Payment of the Appeal Brief fee set forth in 37 C.F.R. §41.20(b)(2) is submitted herewith. Accordingly, this Appeal Brief is being timely submitted, and Appellants' believe that no additional fees are necessary at this time. However, if any fees are necessary for consideration of this Appeal Brief, the undersigned authorizes the charging of any filing fees for the Appeal Brief and/or any necessary extension of time fees to Deposit Account No. 09-0456.

(I) REAL PARTY IN INTEREST

The real party in interest is International Business Machines Corporation of Armonk, New York, assignee of the entire interest in the above-identified application by an assignment recorded in the U.S. Patent and Trademark Office on October 4, 2004, at Reel 015211 and Frame 0471.

(II) RELATED APPEALS AND INTERFERENCES

The Appellants, their legal representatives and the Assignees are not currently aware of any appeals, interferences, or judicial proceedings that may directly affect or be directly affected by or have some bearing on the Board's decision in this appeal. Attached hereto is a Related Proceedings Appendix showing no related appeals or interferences.

(III) STATUS OF THE CLAIMS

In the Final Office Action dated August 18, 2009 ("Final Office Action"), claims 1, 4-10, 12-14, and 21-28 are pending and rejected. Claims 2, 3, 11, and 15-20 are canceled. No claims are allowed, objected to, or withdrawn. Accordingly, claims 1, 4-10, 12-14, and 21-28 are being appealed and are listed in the "Claims Appendix" attached herewith.

(IV) STATUS OF THE AMENDMENTS

All amendments have been entered. No amendments to the claims have been filed after the Final Office Action. Accordingly, claims 1, 4-10, 12-14, and 21-28 as presented in the RCE and Amendment filed January 5, 2009, are being appealed and are listed in the "Claims Appendix" attached herewith.

(V) SUMMARY OF THE CLAIMED SUBJECT MATTER**Independent Claim 1**

By way of non-limiting example, the invention provides a method of semiconductor fabrication. The method includes forming a sidewall image transfer (SIT) loop on a substrate 5 such that the SIT loop forms a hard mask 10 having a width substantially equal to a critical width of a narrow section 16 of a target shape 12 (see, e.g., FIG. 1, and page 4, lines 3-28).

The method also includes protecting a pair of critical edges of the hard mask 10 on the substrate 5 with a first portion 22 of a follow-on mask 18, wherein a width of the first portion 22 of the follow-on mask 18 exceeds the critical width by an amount of overlap 32, and a width of a wide section 20 of the follow-on mask 18 exceeds a width of a wide section 14 of the target shape 12 (see, e.g., FIGS. 2 and 6; page 4, line 29 through page 5, line 12). The method further includes removing an exposed portion of the hard mask 10 that is not covered by the follow-on mask 18 (see, e.g., FIG. 3, and page 5, lines 13-18). The method also includes exposing the pair of critical edges of the hard mask 10 by etching the follow-on mask 18 to reduce the width of the first portion 22 of the follow-on mask 18 to less than the critical width (see, e.g., FIG. 4, and page 5, lines 19-27).

Independent Claim 8

By way of non-limiting example, the invention provides a method of semiconductor fabrication. The method includes forming a sidewall image transfer (SIT) loop on a substrate 5 such that the SIT loop forms a hard mask 10, wherein a width of the hard mask 10 substantially equals a width of a narrow section 16 of a target shape 12 (see, e.g., FIG. 1, and page 4, lines 3-28).

The method includes forming a follow-on mask 18 in a loop-cutter pattern on a portion of the hard mask 10, wherein the follow-on mask 18 comprises a wide-image section 20 having a width that exceeds a width of a wide section 14 of the target shape 12 and a narrow-image section 22 having a width that exceeds the width of the hard mask 10 (see, e.g., FIGS. 2 and 6; page 4, line 29 through page 5, line 12). The method also includes removing a portion of the hard mask 10 left exposed by the follow-on mask 18 (see, e.g., FIG. 3, and page 5, lines 13-18). The method further includes removing at least a portion of the narrow-image section 22 of the follow-on mask 18 (see, e.g., FIG. 4, and page 5, lines 19-27).

Independent Claim 21

By way of non-limiting example, the invention provides a method of combining a wide-image mask and loop-cutter mask. The method includes forming a sidewall image transfer (SIT) hard mask loop 10 on a substrate 5, wherein a width of a narrow section 16 of a target shape 12 substantially equals a width of the hard mask loop 10, and a width of a wide section 14 of the

target shape 12 exceeds the width of the hard mask loop 10 (see, e.g., FIG. 1, and page 4, lines 3-28). The method also includes forming a follow-on mask 18 over a portion of the hard mask loop 10, wherein the follow-on mask 18 includes a first section 20 corresponding to the wide section 14 of the target shape 12 and a second section 22 overlapping the narrow section 16 of the target shape 12, and a width of the second section 22 of the follow-on mask exceeds the width of the narrow section 16 of the target shape 12 (see, e.g., FIGS. 2 and 6; page 4, line 29 through page 5, line 12).

The method also includes removing regions of the hard mask loop 10 uncovered by the follow on mask 18 (see, e.g., FIG. 3, and page 5, lines 13-18). The method further includes etching the second section 22 of the follow-on mask 18 to expose underlying edges of the hard mask loop 10 (see, e.g., FIG. 4, and page 5, lines 19-27). The method also includes etching the first section 20 of the follow-on mask 18 to reduce its length and width to produce an image pad 24 that substantially conforms to the wide section 14 of the target shape 12 (see, e.g., FIG. 4, and page 5, line 28 through page 6, line 4). The method further includes etching the substrate 5 uncovered by the remaining hard mask loop 10 and image pad 24 (see, e.g., FIG. 5, and page 6, lines 9-17).

(VI) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

(A) Claims 1, 8, and 21, and their dependent claims, are rejected under 35 U.S.C. §112, 2nd paragraph, as being indefinite.

(B) Claims 1, 4-8, 12-14, 21-23, 27, and 28 are rejected under 35 U.S.C. §103(a) for being unpatentable over U.S. Pat. No. 4,538,748 issued to Gruner et al. ("Gruner") in view of what the Examiner characterizes as "Applicants' Admitted Prior Art."¹

(C) Claims 9 and 10 are rejected under 35 U.S.C. §103(a) for being unpatentable over Gruner and "Applicants' Admitted Prior Art," and further in view of U.S. Pub. No. 2005/0106837 issued to Nakai et al. ("Nakai").

¹ Appellants note that claims 24-26 are not listed as rejected at page 2 of the Office Action, yet pages 4-5 of the Office Action set forth an explanation of a rejection of claims 23-26. Clarification of this inconsistency is requested.

(VII) ARGUMENTS**(A) Claims 1, 8, and 21, and their dependent claims, are rejected under 35****U.S.C. §112, 2nd paragraph, as being indefinite.**

The rejection of claims 1, 8, and 21, and their dependent claims under 35 U.S.C. §112, 2nd paragraph, is in error and the decision to reject this claim should be reversed.

According to MPEP §2173.02, the test for definiteness under 35 U.S.C. 112, second paragraph, is whether "those skilled in the art would understand what is claimed when the claim is read in light of the specification." *Orthokinetics, Inc. v. Safety Travel Chairs, Inc.*, 806 F.2d 1565, 1576, 1 USPQ2d 1081, 1088 (Fed. Cir. 1986). Definiteness of claim language must be analyzed, not in a vacuum, but in light of: (A) the content of the particular application disclosure; (B) the teachings of the prior art; and (C) the claim interpretation that would be given by one possessing the ordinary level of skill in the pertinent art at the time the invention was made. Appellants submit that the claims are clear and definite when read in light of the specification and with the knowledge generally available to one of ordinary skill in the art.

For example, a target shape having a narrow section and wide section and a follow-on mask having a wide section and a narrow section are both described in at pages 4-5 of Appellants' Specification, which state:

The target shape 12 is the final shape to which the underlying substrate will be formed using the hard mask loop 10 and a follow-on mask. The target shape 12 includes a wide section 14 and a narrow section 16. The wide section 14 of the target shape 12 overlaps the hard mask loop 10; whereas, the narrow section 16 of the target shape 12 coincides with a portion of the hard mask loop 10.

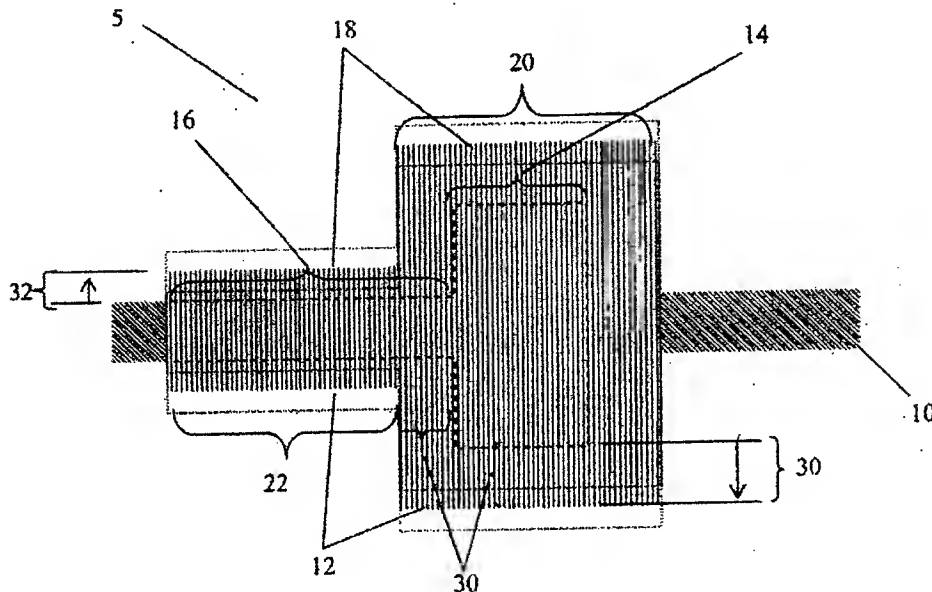
...

Referring to FIG. 2, a follow-on mask 18 is formed over a portion of the hard mask loop 10. The follow-on mask 18 includes a wide section 20, which corresponds to the wide section 14 of the target shape 12. The follow-on mask 18 also includes a narrow section 22 which corresponds to the narrow section 16 of the target shape 12. The follow-on mask 18 may be formed by any of the methods well known in the art suitable for forming a follow-on mask over a hard mask loop including, expanding a desired wide-feature design by an undercut/ashback amount, and adding tabs to cover desired portions of the hard mask loop 10.

Also, the respective narrow and wide sections of both the target shape and the follow-on mask are depicted in Appellants' FIGS. 1-3 and FIG. 6. For example, Appellants' FIG. 6

(reproduced below) shows a relationship between the narrow section 16 and wide section 14 of the target shape 12, and the narrow section 22 and wide section 20 of the follow-on mask 18.

FIG. 6



Moreover, passages at pages 6-7 of Appellants' Specification describe the relationship between the narrow and wide sections of the target shape and the follow-on mask. More specifically, Appellants' Specification states:

Referring to FIG. 6, the size and overlap of the follow-mask 18 over the hard mask loop 10 is shown. The target image shape 12 is shown having a wide section 14 and a narrow section 16. The narrow section 16 of the target shape 12 corresponds to the critical edges of the underlying hard mask loop 10. The follow-on mask 18 includes a wide section 20 and a narrow section 22. As indicated above, one purpose of the narrow section 22 of the follow-on mask 18 is to preserve the underlying section of hard mask 10 during the hard mask loop 10 cutting or etching process. Thus, the narrow section 22 of the follow-on mask 18 should extend beyond the edges of the hard mask loop 10 in order to protect those precision or critical edges.

The amount by which the follow-on mask 18 extends beyond the edges of the underlying hard mask loop 10 is the overlap 32. The amount by which the follow-on masks 18 extends beyond the edges of the wide section 14 of target image 12 is the extended section 30. Initially, the extended section 30 is generally larger than the overlap 32. The amount by which the target image 12 is extended to form the follow-on mask 18 should preferably be sufficient so that despite

follow-on mask 18 registration and image size errors, substantially all critical edges of the underlying hard mask 10 material remain covered during the loop etching process to avoid degrading the wanted portions such as the precision edges of the hard mask 10. In other words, because preserving edges of the loop material maintains control of critical widths afforded by SIT processing, the amounts by which the original (designed) pattern of the follow-on mask is expanded (32, 30) have to be sufficient so that, despite follow-on mask registration and image size errors, all critical edges of that loop material remain covered during loop-cutting in order to prevent degrading line width control.

(Specification, pages 6-7).

Accordingly, Appellants submit that one of ordinary skill in the art reviewing the claims in light of the Specification and Drawings would understand the meaning of the recited narrow section and wide section of the target shape, and also of the recited first portion and wide section of the follow-on mask.

Furthermore, According to MPEP §2173.04, breadth of a claim is not to be equated with indefiniteness. *In re Miller*, 441 F.2d 689, 169 USPQ 597 (CCPA 1971). As such, Appellants submit that the terms “narrow” and “wide” do not need to be defined by specific quantitative dimensions in order for the claims to be definite, as seemingly asserted by the Examiner.

For all of the above-noted reasons, Appellants submit that one of ordinary skill in the art would reasonably ascertain the scope of the claim when analyzing the claim in light of the content of the instant application disclosure and the teachings of the prior art. Therefore, the Examiner has committed clear error in rejecting claims 1, 8, and 21, and their dependent claims, under 35 U.S.C. §112, 2nd Paragraph.

Accordingly, Appellants respectfully request that the §112, 2nd Paragraph, rejection of claims 1, 8, and 21, and their dependent claims, be reversed.

(B) Claims 1, 4-8, 12-14, 21-23, 27, and 28 are rejected under 35 U.S.C. §103(a) for being unpatentable over U.S. Pat. No. 4,538,748 issued to Gruner et al. (“Gruner”) in view of what the Examiner characterizes as “Applicants’ Admitted Prior Art”.

Claims 1, 25, and 26

The rejection of claims 1, 25, and 26 under 35 U.S.C. §103(a) is in error, and the decision to reject these claims should be reversed.

To establish a *prima facie* case of obviousness, all claim limitations must be taught or suggested by the prior art. *See, In re Royka*, 490 F.2d 981, 985, 180 USPQ 580, 583 (CCPA 1974); *see also, In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).² If the prior art reference(s) do not teach or suggest all of the claim limitations, Office personnel must explain why the differences between the prior art and the claimed invention would have been obvious to one of ordinary skill in the art (MPEP 2141). Appellants submit that no proper combination of the applied art teaches or suggests each and every feature of the claimed invention.

The Rejection Does not Address the Language of the Current Claims.

Appellants initially submit that the rejection of claim 1 is improper and should be reversed because the rejection does not address the language recited in the current claims. That is, the explanation of the rejection addresses language of a previous claim set that has since been amended. Independent claims 1, 8, and 21 were amended in an Amendment Under 37 C.F.R. 1.114 on January 5, 2009 (the “RCE Amendment”). However, the Examiner’s rejection in the Final Office Action does not address the claims as amended. Instead, the rejection appears to be based on the language of the previous claim set from the Amendment Under 37 C.F.R. 1.111 dated April 30, 2008. Therefore, the rejection fails to establish a *prima facie* case of obviousness and should be reversed for this reason alone.

For example, claim 1 recites *forming a sidewall image transfer (SIT) loop on a substrate such that the SIT loop forms a hard mask having a width substantially equal to a critical width of a narrow section of a target shape*. The rejection is completely silent with respect to the recitation “*having a width substantially equal to a critical width of a narrow section of a target shape*,” which was added by the RCE Amendment.

As another example that the rejection is based on an outdated set of claims, and not the current claims, Appellants point out that the rejection addresses features that were omitted via the RCE Amendment. Particularly, the Examiner states that Gruner discloses “forming a wide-image mask on the left and right regions ... of the substrate proximate the hard mask with a second portion of the second mask” (Final Office Action, page 3). However, the recitation

² While the *KSR* court rejected a rigid application of the teaching, suggestion, or motivation (“TSM”) test in an obviousness inquiry, the [Supreme] Court acknowledged the importance of identifying “a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does” in an obviousness determination. *Takeda Chemical Industries, Ltd. v. Alphapharm Pty., Ltd.*, 492 F.3d 1350, 1356-1357 (Fed. Cir. 2007) (quoting *KSR International Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1731 (2007)).

“forming a wide image mask ...” was omitted from claim 1 in the RCE Amendment. No current claim recites “forming a wide image mask” As such, the explanation of the rejection contains references to recitations that were in a previous claim set but are no longer in the current claims.

As discussed above, the Examiner has failed to address features of claim 1 that were added by the RCE Amendment, and also refers to recitations that were omitted by the RCE Amendment. This provides clear evidence that the Examiner has based the rejection on a previous claim set, and not the current claims as amended in the RCE Amendment dated January 5, 2009. This alone represents clear and reversible error on the part of the Examiner, and renders the rejection unsustainable. MPEP §2143.03 states:

All words in a claim must be considered in judging the patentability of that claim against the prior art. *In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970)....

Moreover, 37 C.F.R. §1.104 states [emphasis added]:

The examination shall be complete with respect both to compliance of the application or patent under reexamination with the applicable statutes and rules and to the patentability of the invention as claimed

In this case, as evidenced by the discussion above, the Examiner has failed to consider all of the words in independent claim 1 as amended in the RCE Amendment dated January 5, 2009. Instead, the Examiner addressed the language of a previous claim set. Thus, the Examiner has committed clear error and has failed to establish a *prima facie* case of obviousness.

The Applied Art Does not Teach All of the Recited Features.

The invention relates to semiconductor fabrication, and more particularly to fabricating a combination of small and large structures. More specifically, independent claim 1 recites:

1. A method of semiconductor fabrication, comprising the steps of:
 - forming a sidewall image transfer (SIT) loop on a substrate such that the SIT loop forms a hard mask having a width substantially equal to a critical width of a narrow section of a target shape;
 - protecting a pair of critical edges of the hard mask on the substrate with a first portion of a follow-on mask, wherein a width

of the first portion of the follow-on mask exceeds the critical width by an amount of overlap, and a width of a wide section of the follow-on mask exceeds a width of a wide section of the target shape;

removing an exposed portion of the hard mask that is not covered by the follow-on mask; and

exposing the pair of critical edges of the hard mask by etching the follow-on mask to reduce the width of the first portion of the follow-on mask to less than the critical width.

The Examiner asserts that Gruner's nickel layer 5 constitutes the recited hard mask, and that Gruner's photoresist mask 90 constitutes the recited follow-on mask (Final Office Action, page 3). The Examiner acknowledges, and Appellants agree, that Gruner is silent with respect to a sidewall image transfer (SIT) loop. The Examiner notes that the Background Section of Appellants' Specification describes sidewall image transfer (SIT) techniques (Final Office Action, pages 3-4). The Examiner concludes that it would have been obvious to apply the process of Gruner to any substrate including a substrate comprising an SIT loop (Final Office Action, page 4). Notwithstanding, Appellants submit that no proper combination of the applied art discloses or suggests the combination of features recited in claim 1.

As the Examiner acknowledges, Gruner does not disclose sidewall image transfer (SIT) techniques. Instead, Gruner only discloses photo-lithographic imaging. Although Appellants generally describe SIT techniques in the Background section of the specification, Appellants do not acquiesce in the Examiner's assertion that the features of the claims are "admitted prior art." In any event, Appellants submit that no proper combination of Gruner and "Applicants' Admitted Prior Art" teaches the combination of: (i) *forming a sidewall image transfer (SIT) loop on a substrate such that the SIT loop forms a hard mask having a width substantially equal to a critical width of a narrow section of a target shape* and (ii) *protecting a pair of critical edges of the hard mask on the substrate with a first portion of a follow-on mask, wherein a width of the first portion of the follow-on mask exceeds the critical width by an amount of overlap, and a width of a wide section of the follow-on mask exceeds a width of a wide section of the target shape*, as recited in claim 1.

More specifically, Gruner does not disclose a target shape having a narrow section and a wide section. Instead, Gruner only shows side views of the semiconductor structure, and makes no mention of a target shape that has both a narrow section and a wide section. Furthermore, the

Examiner has failed to identify in Gruner a target shape having a narrow section and a wide section. Therefore, Gruner cannot reasonably be construed as teaching the combination of *forming a sidewall image transfer (SIT) loop on a substrate such that the SIT loop forms a hard mask having a width substantially equal to a critical width of a narrow section of a target shape and protecting a pair of critical edges of the hard mask on the substrate with a first portion of a follow-on mask, wherein a width of the first portion of the follow-on mask exceeds the critical width by an amount of overlap, and a width of a wide section of the follow-on mask exceeds a width of a wide section of the target shape*, as recited in claim 1.

Moreover, Appellants submit that the applied art fails to disclose or suggest *protecting a pair of critical edges of the hard mask on the substrate with a first portion of a follow-on mask, wherein a width of the first portion of the follow-on mask exceeds the critical width by an amount of overlap, and a width of a wide section of the follow-on mask exceeds a width of a wide section of the target shape*, as recited in claim 1. The Examiner asserts that Gruner's photoresist mask 90 is a follow-on mask that protects critical edges of the nickel layer 5 (Final Office Action, page 3). Notwithstanding, Appellants submit that mask 90 does not have both (1) a first portion whose width exceeds the critical width by an amount of overlap, and (2) a wide section whose width exceeds a width of a wide section of the target shape. To the contrary, Gruner's photoresist mask 90 does not extend width-wise beyond the width of any shape that it covers (see, e.g., FIGS. 2e-2h).

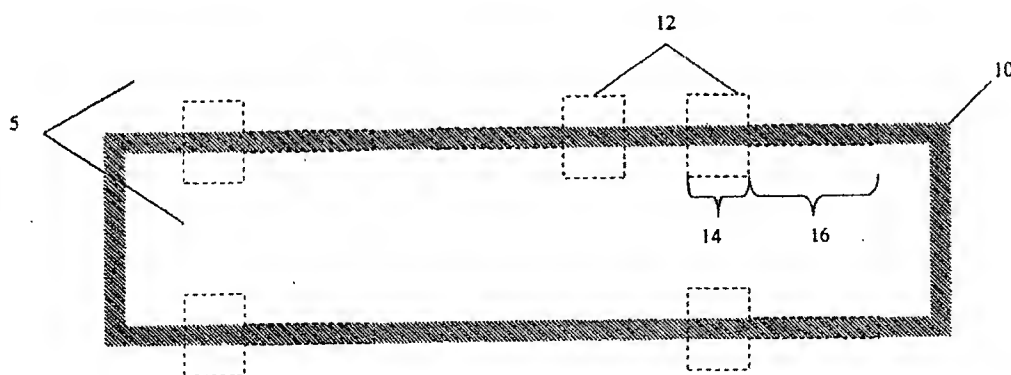
At page 5 of the Final Office Action, the Examiner admits that Gruner "is silent about a width of the first portion of the follow-on mask exceeds the critical width by an amount of overlap, and a width of a wide section of the follow-on mask exceeds a width of a wide section of the target shape." The Examiner asserts, however, that Appellants have failed to define the relative terms of degree such as "wide" and "narrow" in such a way as to distinguish the claimed invention from the prior art of record (Final Office Action, page 5). Appellants respectfully disagree.

The Examiner appears to be ignoring the recitation *a width of the first portion of the follow-on mask exceeds the critical width by an amount of overlap, and a width of a wide section of the follow-on mask exceeds a width of a wide section of the target shape* because Appellants have not provided explicit quantitative examples of the terms "wide" and "narrow." This renders the rejection unsustainable since the language of the claim must be considered and evaluated for

what it would convey to one of ordinary skill in the art. As discussed in greater detail below, the width of the follow-on mask exceeds the critical width by an amount of overlap in order to protect the critical edges of the hard mask in the event of registration and image size errors.

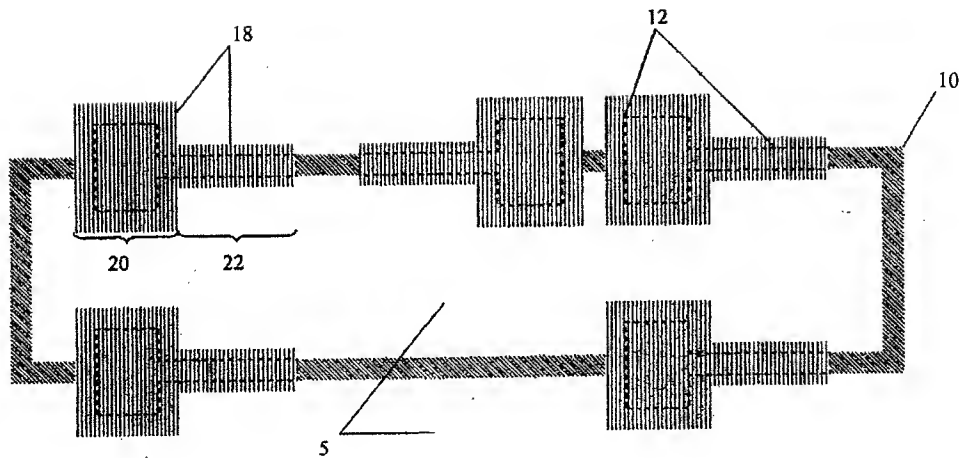
More specifically, in exemplary embodiments of the invention, a target shape 12 to be fabricated in a substrate 5 has a narrow section 16 and a wide section 14 (shown in Appellants' FIG. 1, reproduced below). According to aspects of the invention, a sidewall image transfer (SIT) loop is formed as a hard mask loop 10 over portions of the target shape 12. The hard mask loop 10 having a width that is equal to and coincident with a width of the narrow section 16 of the target shape 12 (i.e., the critical width).

FIG. 1



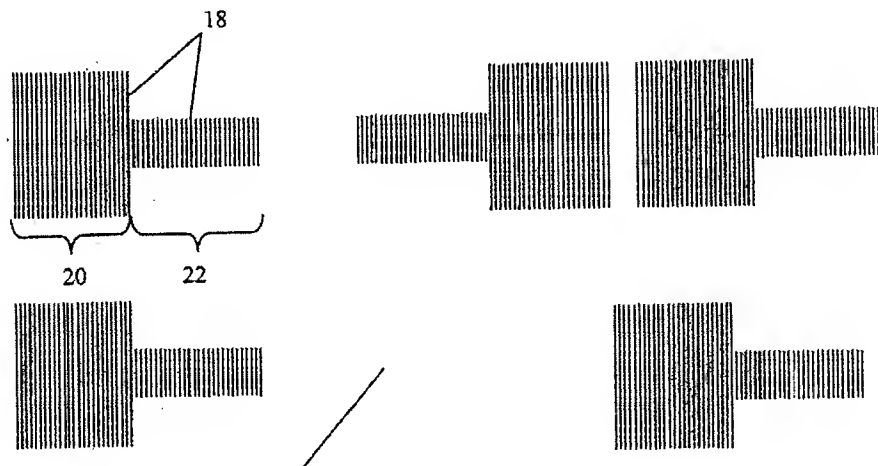
As depicted in Appellants' FIG. 2, reproduced below, a follow-on mask 18 is formed over portions of the hard mask loop 10 and the target shape 12. For example, the follow-on mask 18 has a first (e.g., narrow) portion 22 formed over the narrow section 16 of the target shape 12, wherein the first (e.g., narrow) portion 22 of the follow-on mask 18 has a width that exceeds the width of the narrow section 16 of the target shape by an amount of overlap. Also, the follow-on mask has a second (e.g., wide) portion 20 formed over the wide section 14 of the target shape 12, wherein the second (e.g., wide) portion 20 of the follow-on mask 18 has a width that exceeds the width of the wide section 14 of the target shape 12.

FIG. 2



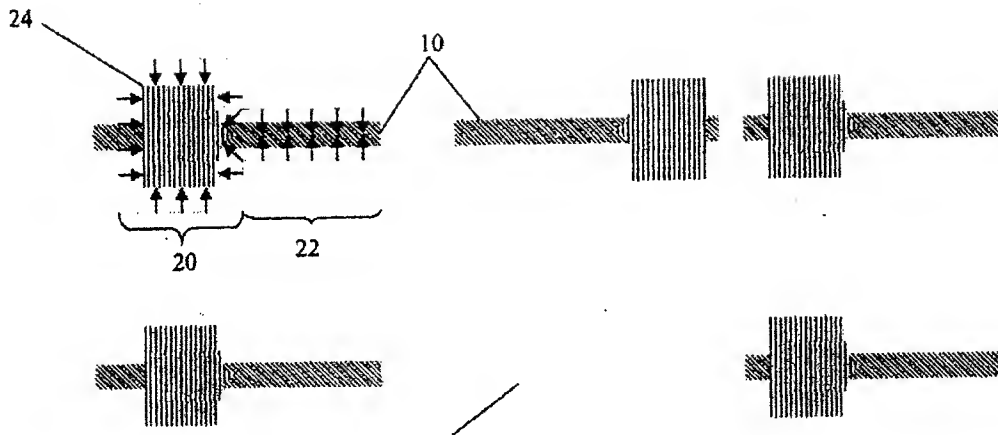
After formation of the follow-on mask 18, uncovered portions of the hard mask loop 10 are removed (e.g., etched away), as shown in Appellants' FIG. 3, reproduced below. In this manner, unnecessary portions of the hard mask 10 that are not used in patterning the target shaped 12 in the underlying substrate are removed.

FIG. 3



Then, as depicted in Appellant's FIG. 4 (reproduced below), the first (narrow) portion 22 of the follow-on mask 18 is etched to reduce its width to less than the critical width of the hard mask 10, thereby exposing the critical edges of the hard mask 10. The hard mask 10 is then available for use in etching the target shape 12 in the underlying substrate 5.

FIG. 4



The follow-on mask 18 enables cutting the hard mask 10 into segments and adds larger features to the image formed by the hard mask 10, without interfering with the accuracy for those portions of the final image formed by the hard mask 10. In this manner, implementations of the invention provide a reduction in the number of masks required to form a final image. Moreover, by employing a follow-on mask 18 with an overlap beyond the critical edges of the hard mask 10, implementations of the invention provide protection for the critical edges of the hard mask 10 from degradation that would otherwise occur in the event of follow-on mask registration and image size errors. This is explicitly described in the following passages of Appellants' Specification:

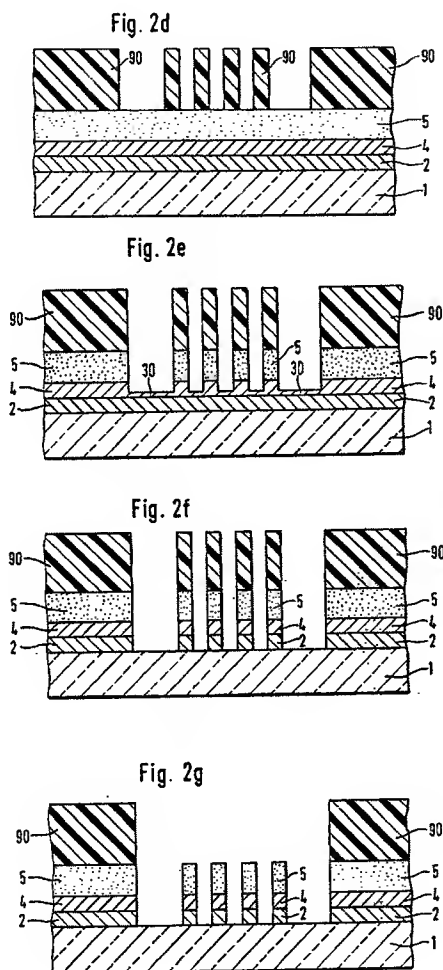
Referring to FIG. 6, the size and overlap of the follow-mask 18 over the hard mask loop 10 is shown. The target image shape 12 is shown having a wide section 14 and a narrow section 16. The narrow section 16 of the target shape 12 corresponds to the critical edges of the underlying hard mask loop 10. The follow-on mask 18 includes a wide section 20 and a narrow section 22. As indicated above, one purpose of the narrow section 22 of the follow-on mask 18 is to preserve the underlying section of hard mask 10 during the hard mask loop 10 cutting or etching process. Thus, the narrow section 22 of the follow-on mask 18 should extend beyond the edges of the hard mask loop 10 in order to protect those precision or critical edges.

The amount by which the follow-on mask 18 extends beyond the edges of the underlying hard mask loop 10 is the overlap 32. The amount by which the follow-on masks 18 extends beyond the edges of the wide section 14 of target image 12 is the extended section 30. Initially, the extended section 30 is generally larger than the overlap 32. The amount by which the target image 12 is extended to form the follow-on mask 18 should preferably be sufficient so that despite

follow-on mask 18 registration and image size errors, substantially all critical edges of the underlying hard mask 10 material remain covered during the loop etching process to avoid degrading the wanted portions such as the precision edges of the hard mask 10. In other words, because preserving edges of the loop material maintains control of critical widths afforded by SIT processing, the amounts by which the original (designed) pattern of the follow-on mask is expanded (32, 30) have to be sufficient so that, despite follow-on mask registration and image size errors, all critical edges of that loop material remain covered during loop-cutting in order to prevent degrading line width control.

(Specification, pages 6-7).

Gruner does not disclose or suggest forming a follow-on mask having a first portion that overlaps a critical width of a hard mask and then reducing the width of the first portion to less than the critical width. Instead, Gruner discloses forming the photoresist mask 90 to correspond exactly with the desired dimension of the nickel layer 5, as shown in Gruner's FIGS. 2d-2g, reproduced below.



Gruner does not disclose any amount of overlap of the photoresist mask 90 compared to a critical width (i.e., the resultant edges) of the nickel layer 5. Instead, Gruner discloses that the photoresist mask 90 is coincident with the resultant edges of the nickel layer 5. As such, the edges of Gruner's nickel layer 5 would not be protected in the event of a misalignment or sizing error of the photoresist mask 90. Therefore, contrary to the Examiner's assertions, there is a structural and functional difference between the disclosure of Gruner and independent claim 1, which recites *protecting a pair of critical edges of the hard mask on the substrate with a first portion of a follow-on mask, wherein a width of the first portion of the follow-on mask exceeds the critical width by an amount of overlap, and a width of a wide section of the follow-on mask exceeds a width of a wide section of the target shape.*

The Examiner explicitly admits that Gruner does not teach *protecting a pair of critical edges of the hard mask on the substrate with a first portion of a follow-on mask, wherein a width of the first portion of the follow-on mask exceeds the critical width by an amount of overlap, and a width of a wide section of the follow-on mask exceeds a width of a wide section of the target shape*, as recited in claim 1 (Final Office Action, page 5). The Examiner does not factually establish that such a feature is well known in the art. Nor does the Examiner even assert that it would have been obvious to modify Gruner to include such a feature. Instead, the Examiner merely alleges that Appellants have failed to define the relative terms of degree such as "wide" and "narrow" in such a way as to distinguish the claimed invention from the prior art of record (Final Office Action, page 5), and concludes that the claimed invention is therefore obvious in view of Gruner. However, as discussed above, forming a follow-on mask in which a width of a first portion of the follow-on mask exceeds a critical width of a hard mask by an amount of overlap does indeed produce a structural and functional difference between Appellants' claimed invention and the disclosure of Gruner.

What the Examiner refers to as "Applicants Admitted Prior Art" does not cure the deficiencies of Gruner with respect to claim 1. Appellants' do not admit in the Specification, or anywhere during prosecution of the instant application, that the following features are known: (i) *forming a sidewall image transfer (SIT) loop on a substrate such that the SIT loop forms a hard mask having a width substantially equal to a critical width of a narrow section of a target shape;* and (ii) *protecting a pair of critical edges of the hard mask on the substrate with a first portion*

of a follow-on mask, wherein a width of the first portion of the follow-on mask exceeds the critical width by an amount of overlap, and a width of a wide section of the follow-on mask exceeds a width of a wide section of the target shape. Therefore, Gruner and “Applicants Admitted Prior Art” do not teach or suggest the combination of features recited in claim 1.

Moreover, Appellants submit that the Background section of the Specification does not include an explicit admission that anything discussed therein is prior art as it relates to determining patentability of the claimed invention. The mere description of a topic in the Background section does not *per se* make that topic “admitted prior art.” There is no admission in the Background section of the Specification, or anywhere else on the record, that the topics discussed in the Background section were: known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent; patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States; or, described in an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent. As such, Appellants submit that it is improper for the Examiner to rely on the discussion in the Background section of the Specification as prior art for formulating the rejection under §103(a).

As such, the Examiner has not factually established how the applied prior art teaches the combination of features recited in claim 1. Therefore, for at least this reason, the Examiner has committed clear error in rejecting claim 1 under 35 U.S.C. §103(a) in view of Gruner and “Applicants Admitted Prior Art.”

The Proposed Combination Would Not Result in the Claimed Invention.

Still regarding claim 1, the Examiner acknowledges, and Appellants agree, that Gruner does not disclose sidewall image transfer (SIT) techniques (Final Office Action, page 3). The Examiner notes that the Background section of Appellants’ Specification describes sidewall image transfer (SIT) techniques (Final Office Action, pages 3-4). The Examiner concludes:

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the process of Gruner to any substrate including a substrate comprising a STI loop.

One of ordinary skill in the art would have been motivated to apply the process of Gruner to any substrate including a substrate comprising a STI loop in order to effectively protect the edges of layers that are susceptible to damage during the subsequent processing steps as suggested by Gruner.

(Final Office Action, page 4).

Appellants submit that applying the process of Gruner to a substrate having an SIT loop would not result in the claimed invention. Gruner discloses a conventional photolithographic process. In Gruner, a photoresist mask 90 is formed over a nickel layer 5, and the photoresist mask 90 is used to etch a pattern in the nickel layer 5 and underlying layers. However, in contrast to the claimed invention, Gruner does not disclose a target shape having a narrow portion and a wide portion, as recited in claim 1. Moreover, Gruner does not disclose forming the photoresist mask 90 such that a first portion of the photoresist mask 90 exceeds a critical width of the nickel layer 5. Furthermore, Gruner does not disclose forming the photoresist mask 90 such that a second portion of the photoresist mask 90 exceeds a width of a wide section of the nickel layer 5. Therefore, contrary to the Examiner's assertions, simply applying the Gruner process to an SIT loop (instead of nickel layer 5) would not result in the claimed invention.

The Proposed Combination Would Not Have Been Obvious.

As noted above, the Examiner asserts that it would have been obvious to apply the process of Gruner to any substrate, including a substrate having an SIT loop. Appellants disagree, and submit that it would not have been obvious to apply Gruner's photolithographic techniques to a substrate having an SIT loop.

As previously discussed during the prosecution of this application, sidewall image transfer (SIT) techniques are recognized in the art as being different from conventional photolithographic imaging techniques, such as those utilized by Gruner. Technical information regarding sidewall image transfer (SIT) techniques is provided in the documents cited in the Information Disclosure Statements filed on March 31, 2005 and April 30, 2008, respectively. With particular regard to the difference between sidewall image transfer (SIT) techniques and

conventional photolithographic imaging techniques, the Background of Appellants' specification states:

As the size of semiconductor devices has decreased, photolithographic techniques become unable to reliably create structures of the dimensions required. As photolithographic techniques have become unusable, other technologies have been developed to create the small structures required by the ever shrinking semiconductor devices. One example of a non-photolithographic imaging technique is sidewall image transfer ("SIT").

SIT is able to produce structures substantially narrower than the minimum size achievable with photolithographic techniques, while maintaining excellent width control.

(Appellants' specification, page 1).

Moreover, as described in U.S. Pub. No. 2006/0084243:

[0004] Alternatives to the photolithographic process in patterning have already been explored in the art. One such method is the spacer image transfer (SIT) method which has a relatively long history, commencing with the publication: C. Johnson et al., "Method of Making Submicron Dimensions in Structures Using Sidewall Image Transfer Techniques", IBM Technical Disclosure Bulletin, vol. 26, No. 9, February 1984, pp. 4587-4589. The SIT method uses sidewall deposition and etching properties for creating thin lines.

Also, as described in U.S. Pat. No. 6,875,703:

Sidewall Image Transfer (SIT) techniques form conductors with very narrow widths or semiconductor devices with very short gate lengths without using critical photolithography. Sidewall Image Transfer has been proposed as a way to produce well-controlled images having sub-lithographic dimensions.

(column 2, lines 3-9).

Based on this evidence, Appellants respectfully submit that sidewall image transfer (SIT) techniques are recognized in the art as being different from photolithographic imaging techniques. There is no teaching or suggestion in this evidence that one can simply apply photolithographic techniques to an existing SIT hard mask loop. Therefore, contrary to the

Examiner's assertions, one of ordinary skill in the art would not have been prompted to apply the Gruner photolithographic imaging techniques to an SIT loop.

For all of the above-discussed reasons, Appellants submit that the rejection of independent claim 1 is in error. Claims 25 and 26 depend from claim 1 and stand or fall with claim 1. Accordingly, Appellants request that the rejection of claims 1, 25, and 26 be reversed.

Claims 4 and 5

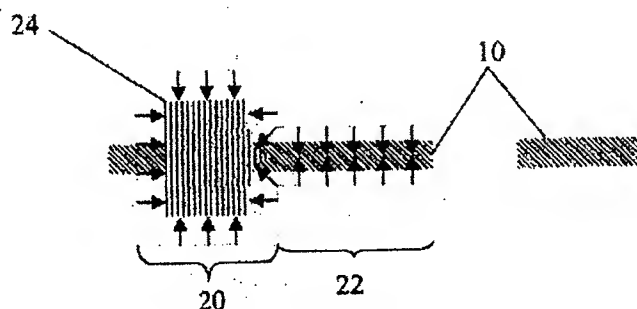
The rejection of claims 4 and 5 under 35 U.S.C. §103(a) is in error, and the decision to reject these claims should be reversed.

Claim 4 depends from independent claim 1 and additionally recites *the exposing the pair of critical edges of the hard mask comprises etching the first portion of the follow-on mask from a side of the first portion of the follow-on mask*. Claim 5 depends from claim 4. The Examiner asserts that Gruner's mask 91 is also considered a follow-on mask, and that in FIG. 2m the mask 91 is removed from the top and sides (Final Office Action, page 5). Appellants disagree.

First, claim 4 recites "the follow-on mask" which refers to the same follow-on mask recited in claim 1. In the claimed invention there is only a single recited follow-on mask. Gruner's mask 91 is different from Gruner's mask 90. Gruner does not disclose a single follow-on mask that satisfies the recitations of claims 1 and 4.

Additionally, there is no evidence that Gruner's mask 91 is etched from a side of the mask. In embodiments, of the invention, portions of the follow-on mask 18 are etched from the sides in order to reduce the width of the follow-on mask 18. This is depicted in Appellants' FIG. 4, a portion of which is reproduced below.

FIG. 4



Gruner makes no mention of etching mask 91 from the side, as recited and described in Appellants' invention. Nor has the Examiner identified any teaching in Gruner that the mask 91, or any other mask, is etched from the side.

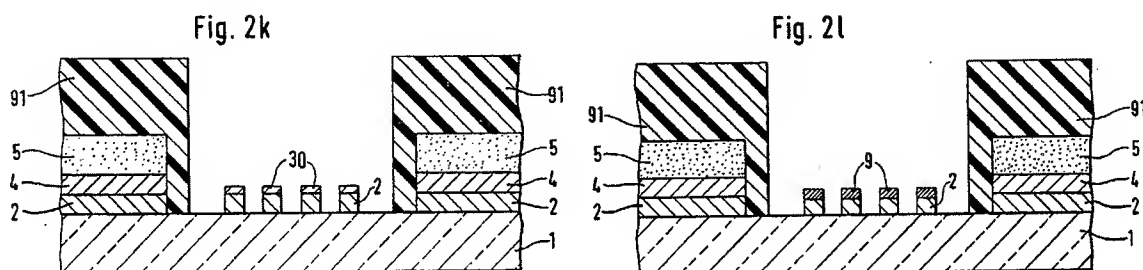
Therefore, the applied art does not disclose or suggest all of the features of claim 4, and does not render claim 4 unpatentable. Claim 5 depends from claim 4 and stands or falls with claim 4. Accordingly, Appellants request that the rejection of claims 4 and 5 be reversed.

Claim 6

The rejection of claim 6 under 35 U.S.C. §103(a) is in error, and the decision to reject this claim should be reversed.

Claim 6 depends from claim 5 and additionally recites *replacing a portion of the removed section of the sidewall of the second portion of the follow-on mask so that the second portion of the follow-on mask substantially aligns with the wide section of the target shape*. The Examiner asserts that Gruner's mask 91 replaces mask 90 and is aligned with edges (Final Office Action, page 5). Appellants disagree.

Gruner's mask 91 does not substantially align with a wide section of a target shape. Instead, as seen in FIGS. 2k and 2l, Gruner's mask 91 is provided over nickel layer 5 to protect the nickel layer 5 during an anodic oxidation process of portion 30 of layer 4 that is present on resistance strips 2.



As can be seen from FIGS. 2k and 2l, Gruner's mask 91 is not substantially aligned with a wide section of a target shape, much less a target shape having a wide section and a narrow section, as recited in claim 1. Therefore, the applied art does not disclose or suggest all of the features of claim 6, and does not render claim 6 unpatentable. Accordingly, Appellants request that the rejection of claim 6 be reversed.

Claim 7

The rejection of claim 7 under 35 U.S.C. §103(a) is in error, and the decision to reject this claim should be reversed.

Claim 7 depends from independent claim 1 and additionally recites *sizing the first portion of the follow-on mask to protect the critical edges of the hard mask when the follow-on mask is*

mis-registered by less than a predetermined amount. The Examiner asserts that Gruner's masks 90 and 91 are sized to protect the critical edges (Final Office Action, page 5).

The Examiner's assertion does not even address the language of claim 7. Claim 7 recites *sizing the first portion of the follow-on mask to protect the critical edges of the hard mask when the follow-on mask is mis-registered by less than a predetermined amount.* The Examiner does not even address the recitation regarding that the sizing is done to protect the critical edges when the follow-on mask is mis-registered by less than a predetermined amount.

Moreover at page 6 of the Final Office Action, the Examiner explicitly admits that Gruner does not disclose the features of claim 7. More specifically, the Examiner states:

It is noted Gruner is silent about further comprising sizing the first portion of the follow-on mask to protect the critical edges of the hard mask when the follow-on mask is mis-registered by less than a predetermined amount.

(Final Office Action, page 6).

In any event, Gruner does not disclose or suggest *sizing the first portion of the follow-on mask to protect the critical edges of the hard mask when the follow-on mask is mis-registered by less than a predetermined amount*, as recited in claim 7. Gruner makes no mention of a possible mis-registration of either mask 90/91. In fact, Gruner's mask 90 is perfectly aligned with the edges of the nickel layer 5. As such, if there is a mis-alignment of the mask 90, then this will affect the resultant edges of the nickel layer 5.

In contrast to Gruner, in exemplary embodiments of the claimed invention, the narrow portion of the follow-on mask is initially formed larger than the critical width of the hard mask loop (i.e., having a width that extends beyond the edges of the hard mask loop). After the hard mask loop is cut into segments, then the narrow portion of the follow-on mask is recessed to expose the critical edges of the hard mask loop. By providing the narrow portion of the follow-on mask with an amount of overlap, the edges of the hard mask loop are protected from degradation that might occur as a result of a mis-alignment of the follow-on mask. Gruner, however, makes no such allowance in sizing the mask 90. Instead, mask 90 is exactly coincident with the edges of the nickel layer 5. Therefore, Gruner does not disclose *sizing the first portion of the follow-on mask to protect the critical edges of the hard mask when the follow-on mask is*

mis-registered by less than a predetermined amount, as recited in claim 7. Nor has the Examiner factually established that *sizing the first portion of the follow-on mask to protect the critical edges of the hard mask when the follow-on mask is mis-registered by less than a predetermined amount* is well known in the art, or that it would have been obvious to add such a feature to Gruner.

Accordingly, Appellants request that the rejection of claim 7 be reversed.

Claim 27

The rejection of claim 27 under 35 U.S.C. §103(a) is in error, and the decision to reject this claim should be reversed. Claim 27 depends from independent claim 1 and additionally recites:

... reducing a length and the width of the wide section of the follow-on mask to form a core pad that is smaller than the wide section of the target shape; and
 re-growing the follow-on mask along edges of the core pad to form an image pad that substantially conforms to the wide section of the target shape.

Appellants initially submit that the rejection of claim 27 is unsustainable because the Examiner does not even address the features of claim 27 in the Final Office Action. The Examiner groups claim 27 with the rejection of claims 1, 8, 12-14, 21-22, and 28, but fails to address the unique features that are recited in claim 27 (Final Office Action, page 3). This makes the rejection fatally defective on its face, since MPEP §2143.03 states: “[a]ll words in a claim must be considered in judging the patentability of that claim against the prior art.” *In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970). Moreover, 37 C.F.R. §1.104 states: “[t]he examination shall be complete with respect both to compliance of the application or patent under reexamination with the applicable statutes and rules and to the patentability of the invention as claimed ...” (emphasis added). Moreover, MPEP §707.07(d), states that “[a] plurality of claims should never be grouped together in a common rejection, unless that rejection is equally applicable to all claims in the group.” In this case, the Examiner has committed clear error by grouping claim 27 with the rejection of other claims while failing to address the language of claim 27.

In any event, Appellants submit that Gruner does not disclose, inter alia, *re-growing the follow-on mask along edges of the core pad to form an image pad that substantially conforms to*

the wide section of the target shape. The follow-on mask recited in claim 27 refers back to the same follow-on mask recited in claim 1. The Examiner asserts that Gruner's mask 90 constitutes the follow-on mask recited in claim 1. However, Gruner does not disclose re-growing the mask 90, much less re-growing the mask 90 along edges of the core pad to form an image pad that substantially conforms to the wide section of the target shape. Nor has the Examiner factually established that such a feature is well known in the art.

Moreover, Gruner does not disclose a "core pad" or an "image pad" as recited in claim 27. The Examiner has not identified any teaching of a core pad and an image pad in Gruner. Nor has the Examiner factually established that forming such features as recited in claim 27 is known, or that it would have been obvious to add such features to Gruner.

Therefore, the applied art does not disclose or suggest all of the features of claim 27, and does not render claim 27 unpatentable. Accordingly, Appellants request that the rejection of claim 27 be reversed.

Claims 8 and 12

The rejection of claims 8 and 12 under 35 U.S.C. §103(a) is in error, and the decision to reject these claims should be reversed. Independent claim 8 recites:

8. A method of semiconductor fabrication, comprising the steps of:
 - forming a sidewall image transfer (SIT) loop on a substrate such that the SIT loop forms a hard mask, wherein a width of the hard mask substantially equals a width of a narrow section of a target shape;
 - forming a follow-on mask in a loop-cutter pattern on a portion of the hard mask, wherein the follow-on mask comprises a wide-image section having a width that exceeds a width of a wide section of the target shape and a narrow-image section having a width that exceeds the width of the hard mask;
 - removing a portion of the hard mask left exposed by the follow-on mask; and
 - removing at least a portion of the narrow-image section of the follow-on mask.

The Examiner groups claim 8 with the rejection of claim 1 (Final Office Action, pages 3-5). Particularly, the Examiner asserts that Gruner discloses a hard mask at element 5 and a follow-on mask at element 90. The Examiner admits that Gruner is silent with respect to an SIT loop. The Examiner concludes that it would have been obvious to apply the process of Gruner to

any substrate, including a substrate comprising an SIT loop. Appellants disagree with the conclusion of obviousness for the following reasons.

First, Gruner and “Applicants Admitted Prior Art” does not teach the combination of features recited in claim 8. As discussed above with respect to claim 1, Gruner does not disclose or suggest a target shape having both a narrow section and a wide section. Therefore, Gruner does not teach the combination of: (i) *forming a sidewall image transfer (SIT) loop on a substrate such that the SIT loop forms a hard mask, wherein a width of the hard mask substantially equals a width of a narrow section of a target shape* and (ii) *forming a follow-on mask in a loop-cutter pattern on a portion of the hard mask, wherein the follow-on mask comprises a wide-image section having a width that exceeds a width of a wide section of the target shape and a narrow-image section having a width that exceeds the width of the hard mask*, as recited in claim 8.

Moreover, Gruner does not disclose *forming a follow-on mask in a loop-cutter pattern on a portion of the hard mask, wherein the follow-on mask comprises a wide-image section having a width that exceeds a width of a wide section of the target shape and a narrow-image section having a width that exceeds the width of the hard mask*, as recited in claim 8. As discussed above with respect to claim 1, Gruner does not disclose a follow-on mask that has a wide-image section having a width that exceeds a width of a wide section of the target shape and a narrow-image section having a width that exceeds the width of the hard mask. To the contrary, Gruner’s photoresist mask 90 does not extend width-wise beyond the width of any shape that it covers. Instead, Gruner’s mask 90 coincides exactly with the edges of the nickel layer 5 (i.e., what the Examiner refers to as the hard mask). Therefore, Gruner does not teach *the follow-on mask comprises a wide-image section having a width that exceeds a width of a wide section of the target shape and a narrow-image section having a width that exceeds the width of the hard mask*, as recited in claim 8.

As also discussed above with respect to claim 1, Appellants have not admitted anywhere on the record that the features that are missing from Gruner are known to those of ordinary skill in the art. To the contrary, the Background section of Appellants’ Specification merely describes SIT in general, and does not admit that any of the recited features are well known. Therefore, the applied art fails to teach the combination of features recited in independent claim 8.

Furthermore, Appellants submit that applying the process of Gruner to a substrate having an SIT loop, as proposed by the Examiner, would not result in the claimed invention. Gruner discloses a conventional photolithographic process. In Gruner, a photoresist mask 90 is formed over a nickel layer 5, and the photoresist mask 90 is used to etch a pattern in the nickel layer 5 and underlying layers. However, in contrast to the claimed invention, Gruner does not disclose a target shape having a narrow section and a wide section, as recited in claim 8. Moreover, Gruner does not disclose forming the photoresist mask 90 such that a first portion of the photoresist mask 90 exceeds a critical width of the nickel layer 5. Furthermore, Gruner does not disclose forming the photoresist mask 90 such that a second portion of the photoresist mask 90 exceeds a width of a wide section of the nickel layer 5. Therefore, contrary to the Examiner's assertions, simply applying the Gruner process to an SIT loop (instead of nickel layer 5) would not result in the claimed invention.

Even further, Appellants submit that it would not have been obvious to apply Gruner's photolithographic techniques to a substrate having an SIT loop. As discussed *supra*, sidewall image transfer (SIT) techniques are recognized in the art as being different from conventional photolithographic imaging techniques, such as those utilized by Gruner. Based on the evidence describing SIT, Appellants submit that sidewall image transfer (SIT) techniques are recognized in the art as being different from photolithographic imaging techniques. There is no teaching or suggestion in the evidence that one can simply apply photolithographic techniques (such as that of Gruner) to an existing SIT hard mask loop. Therefore, contrary to the Examiner's assertions, one of ordinary skill in the art would not have been prompted to apply the Gruner photolithographic imaging techniques to an SIT loop.

For all of the above-discussed reasons, Appellants submit that the rejection of independent claim 8 is in error. Claim 12 depends from claim 8 and stands or falls with claim 8. Accordingly, Appellants request that the rejection of claims 8 and 12 be reversed.

Claim 13

The rejection of claim 13 under 35 U.S.C. §103(a) is in error, and the decision to reject this claim should be reversed. Claim 13 depends indirectly from independent claim 8 and additionally recites *forming a re-shaped follow-on mask by re-depositing material onto the wide-image section of the follow-on mask to substantially align the re-shaped follow-on mask with a corresponding portion of a final shape.*

The Examiner groups claim 13 with the rejection of claims 1, 8, 12, 14, 21-22, 27, and 28, but does not address the features of claim 13. However, claim 13 recites features that are not recited in any of claims 1, 8, 12, 14, 21-22, 27, and 28, such that merely grouping claim 13 with these other claims cannot serve to establish a prima facie case of obviousness with respect to claim 13. Therefore, the Examiner has committed clear error by grouping claim 13 with the rejection of other claims without addressing the language of claim 13 (MPEP §2143.03, 37 C.F.R. 1.104, and MPEP §707.07).

In any event, Appellants submit that the applied art does not disclose or suggest *forming a re-shaped follow-on mask by re-depositing material onto the wide-image section of the follow-on mask to substantially align the re-shaped follow-on mask with a corresponding portion of a final shape*, as recited in claim 13. The follow-on mask recited in claim 13 refers to the follow-on mask recited in claim 8. The Examiner asserts that Gruner's mask 90 reads on the follow-on mask of claim 8. However, Gruner does not disclose re-depositing material onto a wide-image section of mask 90, much less re-depositing material onto a wide-image section of mask 90 to substantially align the re-shaped follow-on mask with a corresponding portion of a final shape. Instead, Gruner discloses completely stripping mask 90, and then forming a separate mask 91. However, forming a separate mask is not the same as re-depositing material onto an existing mask, as recited and described in Appellants' invention. Moreover, the Examiner has not factually established that *forming a re-shaped follow-on mask by re-depositing material onto the wide-image section of the follow-on mask to substantially align the re-shaped follow-on mask with a corresponding portion of a final shape*, as recited in claim 13, is well known to those of ordinary skill in the art, or that it would have been obvious to add such a feature to Gruner.

Therefore, the applied art does not disclose or suggest all of the features of claim 13, and does not render claim 13 unpatentable. Accordingly, Appellants request that the rejection of claim 13 be reversed.

Claim 14

The rejection of claim 14 under 35 U.S.C. §103(a) is in error, and the decision to reject this claim should be reversed. Claim 14 depends from independent claim 8 and additionally recites *removing at least a portion of the narrow-image section of the follow-on mask by etching the narrow-image section of the follow-on mask from both a side and a top of the narrow-image section of the follow-on mask*.

The Examiner groups claim 14 with the rejection of claims 1, 8, 12, 13, 21-22, 27, and 28, but does not address the features of claim 13. However, claim 14 recites features that are not recited in any of claims 1, 8, 12, 13, 21-22, 27, and 28, such that merely grouping claim 14 with these other claims cannot serve to establish a prima facie case of obviousness with respect to claim 14. Therefore, the Examiner has committed clear error by grouping claim 14 with the rejection of other claims without addressing the language of claim 14 (MPEP §2143.03, 37 C.F.R. 1.104, and MPEP §707.07).

In any event, Appellants submit that the applied art does not disclose or suggest *removing at least a portion of the narrow-image section of the follow-on mask by etching the narrow-image section of the follow-on mask from both a side and a top of the narrow-image section of the follow-on mask*, as recited in claim 14. Gruner does not disclose removing a portion of mask 90 from both a top and a side of a narrow-image section. In fact, Gruner does not disclose any type of removal that occurs from a top and a side. Nor has the Examiner identified any such teaching in Gruner. Moreover, the Examiner has not factually established that such is known in the art, and that it would have been obvious to add such a feature to Gruner.

Therefore, the applied art does not disclose or suggest all of the features of claim 14, and does not render claim 14 unpatentable. Accordingly, Appellants request that the rejection of claim 14 be reversed.

Claim 28

The rejection of claim 28 under 35 U.S.C. §103(a) is in error, and the decision to reject this claim should be reversed. Claim 28 depends from independent claim 1 and additionally recites:

... reducing a length and the width of the wide-image section of the follow-on mask to form a core pad that is smaller than the wide section of the target shape; and
re-growing the follow-on mask along edges of the core pad to form an image pad that substantially conforms to the wide section of the target shape.

The Examiner groups claim 28 with the rejection of claims 1, 8, 12-14, 21-22, and 27, but does not address the features of claim 28. However, claim 28 recites features that are not recited in any of claims 1, 8, 12-14, and 21-22, such that merely grouping claim 28 with these other claims cannot serve to establish a prima facie case of obviousness with respect to claim 28.

Therefore, the Examiner has committed clear error by grouping claim 28 with the rejection of other claims without addressing the language of claim 28 (MPEP §2143.03, 37 C.F.R. 1.104, and MPEP §707.07).

In any event, Appellants submit that Gruner does not disclose, *inter alia*, *re-growing the follow-on mask along edges of the core pad to form an image pad that substantially conforms to the wide section of the target shape*. The follow-on mask recited in claim 28 refers back to the same follow-on mask recited in claim 8. The Examiner asserts that Gruner's mask 90 constitutes the follow-on mask recited in claim 8. However, Gruner does not disclose re-growing the mask 90, much less re-growing the mask 90 along edges of the core pad to form an image pad that substantially conforms to the wide section of the target shape. Nor has the Examiner factually established that such a feature is well known in the art.

Therefore, the applied art does not disclose or suggest all of the features of claim 28, and does not render claim 28 unpatentable. Accordingly, Appellants request that the rejection of claim 28 be reversed.

Claims 21-24

The rejection of claims 21-24 under 35 U.S.C. §103(a) is in error, and the decision to reject these claims should be reversed. Independent claim 21 recites:

21. A method of combining a wide-image mask and loop-cutter mask, comprising the steps of:

forming a sidewall image transfer (SIT) hard mask loop on a substrate, wherein a width of a narrow section of a target shape substantially equals a width of the hard mask loop, and a width of a wide section of the target shape exceeds the width of the hard mask loop;

forming a follow-on mask over a portion of the hard mask loop, wherein the follow-on mask includes a first section corresponding to the wide section of the target shape and a second section overlapping the narrow section of the target shape, and a width of the second section of the follow-on mask exceeds the width of the narrow section of the target shape;

removing regions of the hard mask loop uncovered by the follow on mask;

etching the second section of the follow-on mask to expose underlying edges of the hard mask loop;

etching the first section of the follow-on mask to reduce its length and width to produce an image pad that substantially conforms to the wide section of the target shape; and

etching the substrate uncovered by the remaining hard mask loop and image pad.

Appellants initially submit that the rejection of claim 21 is improper because the Examiner has failed to address the language of claim 21. The Examiner has grouped claim 21 with the rejection of claim 1, while only addressing the language of claim 1. However, claim 21 recites features that are not recited in claim 1 (e.g., *etching the first section of the follow-on mask to reduce its length and width to produce an image pad that substantially conforms to the wide section of the target shape, and etching the substrate uncovered by the remaining hard mask loop and image pad*), such that an explanation of the rejection of claim 1 cannot serve to establish a *prima facie* case of obviousness with respect to claim 21.

This makes the rejection fatally defective on its face, since MPEP §2143.03 states: “[a]ll words in a claim must be considered in judging the patentability of that claim against the prior art.” *In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970). Moreover, 37 C.F.R. §1.104 states: “[t]he examination shall be complete with respect both to compliance of the application or patent under reexamination with the applicable statutes and rules and to the patentability of the invention as claimed ...” (emphasis added). Moreover, MPEP §707.07(d), states that “[a] plurality of claims should never be grouped together in a common rejection, unless that rejection is equally applicable to all claims in the group.” In this case, the Examiner has committed clear error by improperly grouping claim 21 with the rejection of other claims while failing to address the language of claim 21.

In any event, Appellants submit that no proper combination of the applied art discloses or suggests the combination of features recited in claim 21. As discussed above with respect to claim 1, Gruner does not disclose or suggest a target shape having both a narrow section and a wide section. Therefore, Gruner does not teach the combination of: (i) forming a sidewall image transfer (SIT) hard mask loop on a substrate, wherein a width of a narrow section of a target shape substantially equals a width of the hard mask loop, and a width of a wide section of the target shape exceeds the width of the hard mask loop, and (ii) forming a follow-on mask over a portion of the hard mask loop, wherein the follow-on mask includes a first section corresponding to the wide section of the target shape and a second section overlapping the narrow section of the target shape, and a width of the second section of the follow-on mask exceeds the width of the

narrow section of the target shape, as recited in claim 21. All of the recitations of claim 21 are defined in the context of a target shape. However, the Examiner has not identified any such target shape in Gruner.

Moreover, Gruner does not disclose *forming a follow-on mask over a portion of the hard mask loop, wherein the follow-on mask includes a first section corresponding to the wide section of the target shape and a second section overlapping the narrow section of the target shape, and a width of the second section of the follow-on mask exceeds the width of the narrow section of the target shape*, as recited in claim 21. As discussed above with respect to claim 1, Gruner does not disclose a follow-on mask that has a narrow-image section having a width that exceeds the width of the hard mask. To the contrary, Gruner's photoresist mask 90 does not extend width-wise beyond the width of any shape that it covers. Instead, Gruner's mask 90 coincides exactly with the edges of the nickel layer 5 (i.e., what the Examiner refers to as the hard mask). Therefore, Gruner does not teach *a width of the second section of the follow-on mask exceeds the width of the narrow section of the target shape*, as recited in claim 21.

Furthermore, Gruner does not disclose or suggest *etching the first section of the follow-on mask to reduce its length and width to produce an image pad that substantially conforms to the wide section of the target shape*, as recited in claim 21. Gruner does not disclose etching a section of photoresist mask 90 to reduce its length and width. Instead, Gruner only discloses side views of the fabrication, and makes no mention of reducing a length and width of a feature as seen from above, as in Appellants' claimed invention.

Additionally, Gruner does not disclose an image pad as recited in the claimed invention. To the contrary, Gruner is completely silent as to an image pad that substantially conforms to the wide section of the target shape. Therefore, Gruner cannot arguably be construed as teaching *etching the first section of the follow-on mask to reduce its length and width to produce an image pad that substantially conforms to the wide section of the target shape, and etching the substrate uncovered by the remaining hard mask loop and image pad*, as recited in claim 21. Moreover, Appellants note that the Examiner failed to address these recitations in the Office Action.

As also discussed above with respect to claim 1, Appellants have not admitted anywhere on the record that the features that are missing from Gruner are known to those of ordinary skill in the art. To the contrary, the Background section of Appellants' Specification merely describes SIT in general, and does not admit that any of the recited features of the claims are well known.

Therefore, the applied art fails to teach the combination of features recited in independent claim 21.

Furthermore, Appellants submit that applying the process of Gruner to a substrate having an SIT loop, as proposed by the Examiner, would not result in the claimed invention. Gruner discloses a conventional photolithographic process. In Gruner, a photoresist mask 90 is formed over a nickel layer 5, and the photoresist mask 90 is used to etch a pattern in the nickel layer 5 and underlying layers. However, in contrast to the claimed invention, Gruner does not disclose a target shape having a narrow section and a wide section, as recited in claim 21. Moreover, Gruner does not disclose forming the photoresist mask 90 such that a first portion of the photoresist mask 90 exceeds a critical width of the nickel layer 5. Furthermore, Gruner does not disclose forming the photoresist mask 90 such that a second portion of the photoresist mask 90 exceeds a width of a wide section of the nickel layer 5. Therefore, contrary to the Examiner's assertions, simply applying the Gruner process to an SIT loop (instead of nickel layer 5) would not result in the claimed invention.

Even further, Appellants submit that it would not have been obvious to apply Gruner's photolithographic techniques to a substrate having an SIT loop. As discussed *supra*, sidewall image transfer (SIT) techniques are recognized in the art as being different from conventional photolithographic imaging techniques, such as those utilized by Gruner. Based on the evidence describing SIT, Appellants submit that sidewall image transfer (SIT) techniques are recognized in the art as being different from photolithographic imaging techniques. There is no teaching or suggestion in the evidence that one can simply apply photolithographic techniques (such as that of Gruner) to an existing SIT hard mask loop. Therefore, contrary to the Examiner's assertions, one of ordinary skill in the art would not have been prompted to apply the Gruner photolithographic imaging techniques to an SIT loop.

For all of the above-discussed reasons, Appellants submit that the rejection of independent claim 21 is in error. Claims 22-24 depend from claim 21 and stand or fall with claim 21. Accordingly, Appellants request that the rejection of claims 21-24 be reversed.

(C) Claims 9 and 10 are rejected under 35 U.S.C. §103(a) for being unpatentable over Gruner and “Applicants’ Admitted Prior Art,” and further in view of U.S. Pub. No. 2005/0106837 issued to Nakai et al. (“Nakai”).

The rejection of claims 9 and 10 under 35 U.S.C. §103(a) is in error, and the decision to reject these claims should be reversed. Claims 9 and 10 depend from independent claim 8, and stand or fall with claim 8. Accordingly, Appellants request that the rejection of claims 9 and 10 be reversed for the same reasons as claim 8.

Conclusion

In view of the foregoing remarks, Appellants submit that claims 1, 4-10, 12-14, and 21-28 are patentably distinct from the prior art of record and are in condition for allowance. Accordingly, Appellants respectfully request that the Board reverse the Examiner’s rejection of claims 1, 4-10, 12-14, and 21-28 and remand the application to the Examiner for allowance of the pending claims.

Respectfully submitted,
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(VIII) CLAIMS APPENDIX

The following is a listing of the claims involved in the appeal.

1. A method of semiconductor fabrication, comprising the steps of:

forming a sidewall image transfer (SIT) loop on a substrate such that the SIT loop forms a hard mask having a width substantially equal to a critical width of a narrow section of a target shape;

protecting a pair of critical edges of the hard mask on the substrate with a first portion of a follow-on mask, wherein a width of the first portion of the follow-on mask exceeds the critical width by an amount of overlap, and a width of a wide section of the follow-on mask exceeds a width of a wide section of the target shape;

removing an exposed portion of the hard mask that is not covered by the follow-on mask;
and

exposing the pair of critical edges of the hard mask by etching the follow-on mask to reduce the width of the first portion of the follow-on mask to less than the critical width.

4. The method of claim 1, wherein the exposing the pair of critical edges of the hard mask comprises etching the first portion of the follow-on mask from a side of the first portion of the follow-on mask.

5. The method of claim 4, further comprising removing a section of a sidewall of the wide section of the follow-on mask and then replacing a portion of the removed section of the sidewall of the wide section of the follow-on mask.

6. The method of claim 5, further comprising replacing a portion of the removed section of the sidewall of the second portion of the follow-on mask so that the second portion of the follow-on mask substantially aligns with the wide section of the target shape.

7. The method of claim 1, further comprising sizing the first portion of the follow-on mask to protect the critical edges of the hard mask when the follow-on mask is mis-registered by less than a predetermined amount.

8. A method of semiconductor fabrication, comprising the steps of:

forming a sidewall image transfer (SIT) loop on a substrate such that the SIT loop forms a hard mask, wherein a width of the hard mask substantially equals a width of a narrow section of a target shape;

forming a follow-on mask in a loop-cutter pattern on a portion of the hard mask, wherein the follow-on mask comprises a wide-image section having a width that exceeds a width of a wide section of the target shape and a narrow-image section having a width that exceeds the width of the hard mask;

removing a portion of the hard mask left exposed by the follow-on mask; and

removing at least a portion of the narrow-image section of the follow-on mask.

9. The method of claim 8, further comprising sizing the narrow-image section to cover a portion of the hard mask when the follow-on mask is mis-registered by less than a prescribed amount.

10. The method of claim 8, further comprising sizing the wide-image section of the follow-on mask to substantially align with a corresponding wide section of a final structure.

12. The method of claim 8, further comprising reducing the width of the narrow image section of the follow on mask to an amount less than the width of the hard mask by removing at least a portion of the narrow-image section of the follow-on mask by etching the narrow-image section of the follow-on mask from at least either a side or a top of the narrow-image section of the follow-on mask.

13. The method of claim 12, further comprising forming a re-shaped follow-on mask by re-depositing material onto the wide-image section of the follow-on mask to substantially align the re-shaped follow-on mask with a corresponding portion of a final shape.

14. The method of claim 8, further comprising removing at least a portion of the narrow-image section of the follow-on mask by etching the narrow-image section of the follow-on mask from both a side and a top of the narrow-image section of the follow-on mask.

21. A method of combining a wide-image mask and loop-cutter mask, comprising the steps of:

forming a sidewall image transfer (SIT) hard mask loop on a substrate, wherein a width of a narrow section of a target shape substantially equals a width of the hard mask loop, and a width of a wide section of the target shape exceeds the width of the hard mask loop;

forming a follow-on mask over a portion of the hard mask loop, wherein the follow-on mask includes a first section corresponding to the wide section of the target shape and a second section overlapping the narrow section of the target shape, and a width of the second section of the follow-on mask exceeds the width of the narrow section of the target shape;

removing regions of the hard mask loop uncovered by the follow on mask;

etching the second section of the follow-on mask to expose underlying edges of the hard mask loop;

etching the first section of the follow-on mask to reduce its length and width to produce an image pad that substantially conforms to the wide section of the target shape; and

etching the substrate uncovered by the remaining hard mask loop and image pad.

22. The method of claim 21, wherein the etching the second section of the follow-on mask to expose underlying edges of the hard mask loop comprises completely removing the second section of the follow-on mask from the narrow section of the hard mask loop.

23. The method of claim 22, wherein the SIT hard mask loop is formed using a non-photolithographic imaging technique.

24. The method of claim 23, wherein the SIT hard mask loop is a few tens of nanometers wide.

25. The method of claim 1, wherein the SIT loop is formed using a non-photolithographic imaging technique.

26. The method of claim 25, wherein the SIT loop is a few tens of nanometers wide.

27. The method of claim 1, further comprising:

reducing a length and the width of the wide section of the follow-on mask to form a core pad that is smaller than the wide section of the target shape; and

re-growing the follow-on mask along edges of the core pad to form an image pad that substantially conforms to the wide section of the target shape.

28. The method of claim 8, further comprising:

reducing a length and the width of the wide-image section of the follow-on mask to form a core pad that is smaller than the wide section of the target shape; and

re-growing the follow-on mask along edges of the core pad to form an image pad that substantially conforms to the wide section of the target shape.

(IX) EVIDENCE APPENDIX

This section lists evidence submitted pursuant to 37 C.F.R. §§1.130, 1.131, or 1.132, or any other evidence entered by the Examiner and relied upon by Appellant in this appeal, and provides for each piece of evidence a brief statement setting forth where in the record that evidence was entered by the Examiner. Copies of each piece of Evidence are provided as required by 37 C.F.R. §41.37(c)(1)(ix).

NO.	EVIDENCE	BRIEF STATEMENT SETTING FORTH WHERE IN THE RECORD THE EVIDENCE WAS ENTERED BY THE EXAMINER
1	N/A	N/A

(X) RELATED PROCEEDINGS APPENDIX

Pursuant to 37 C.F.R. §41.37(c)(1)(x), copies of the following decisions rendered by a court or the Board in any proceeding identified above in the Related Appeals and Interferences section.

NO.	TYPE OF PROCEEDING	REFERENCE NO.	DATE
1	N/A	N/A	N/A